



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :  
Yasuyuki KAWAHARA et al.

Appln. No. 10/524843

Group Art Unit: 1714

Filed: 17/02/2007

Examiner: GOLOBOY, JAMES C

For: LUBRICATING OIL FOR BEARING

Commissioner of Patents  
PO Box 1450  
Alexandria, VA 22313-1450

Sir:

**DECLARATION UNDER 37 C.F.R. Section 1.132**

Sir :

I, Yasuyuki KAWAHARA, do hereby declare that:

1. I am a Japanese citizen, residing at 203, 16-6, Nishiura, Gokasho, Uji-shi, Kyoto 611-0011 Japan.
2. I graduated from Department of Chemical Faculty of Engineering of Gifu University, in March 31, 1990 also graduated from the graduate school of Gifu University and received a Doctor's degree in Material Engineering in March 31, 1996.
3. I began my employment with New Japan Chemical Company Limited, the assignee of the above-identified application in April 1 1992. Since January 10, 1995, I have been engaged in the research and development of lubricating Oils.
4. I am one of the named inventors of the above-identified application, and am familiar with the subject matter of said application as well as the disclosures in the cited references.
5. The experiments given below were carried out under my general direction and supervision.

## Experiment I

(1) Procedure of Production Example 1 was repeated with the exception of using 358.49g (3.09 mol) of *n*-hexanoic acid (manufactured by Tokyo Chemical Industry Co., Ltd., reagent, "hexanoic acid") instead of *n*-octanoic acid, giving 377g of 3-methyl-1,5-pentandiol di(*n*-hexanoate).

The total acid number of the thus obtained ester was 0.01 (mg KOH/g), and an FT-IR analysis showed that absorption due to carboxyl groups had disappeared and ester absorption was observed, and therefore it was confirmed that the resulting ester was a diester.

(2) The diester obtained in (1) was used to prepare lubricating oils 1 to 4 with the proportions (parts by weight) shown in Table 1. More specifically, lubricating oil 1 is made only of the diester, lubricating oil 2 has the same composition as that of Example 2 with the exception of using diesters of 3-methyl-1,5-pentandiol with *n*-hexanoic acid instead of the diester (diesters of 3-methyl-1,5-pentandiol with *n*-octanoic acid) of Example 2. Lubricating oils 3 and 4 have the same compositions as those of Examples 3 and 4 with the exception of using diesters of 3-methyl-1,5-pentandiol with *n*-hexanoic acid instead of the diester (diesters of 3-methyl-1,5-pentandiol with *n*-octanoic acid) of Examples 3 and 4.

The obtained lubricating oils were tested for the kinematic viscosity, total acid number, friction coefficient, wear scar diameter (mm) and metal compatibility, in the same manner as described on page 42 line 9 to page 43 line 23 of the specification as filed. Table I shows the

results. For ease of comparison, Table I also shows the results of Examples 2 to 4 shown in Table 1 of the specification as filed.

Table 1

(a) Component	lubricating oil 1	lubricating oil 2	lubricating oil 3	lubricating oil 4	Example 2	Example 3	Example 4
MPD di(n-hexanoate)	100	99.0	96.95	96.89			
MPD di(n-octanoate)					99.0	96.95	96.89
A: MBDBP		0.50	0.50	0.50	0.50	0.50	0.50
B: DBPC							
C: Vanlube81							
D: VanlubeDND		0.50	0.50	0.50	0.50	0.50	0.50
H: Palmitic acid			0.051	0.051		0.051	0.051
I: Stearic acid							
J: TCP			2.04	2.04		2.04	2.04
M: BT				0.051			0.051
N: Propyl gallate							
O: Lauryl gallate				0.01			0.01
Kinematic Viscosity (mm <sup>2</sup> /s)	16.5	17.7	18.5	18.7	29.0	31.0	30.7
0°C	4.93	5.08	5.21	5.23	7.40	7.61	7.61
40°C	1.79	1.80	1.82	1.82	2.42	2.43	2.44
100°C	-	-	-	-	166	156	160
Viscosity Index	0.01	0.01	0.14	0.43	0.01	0.12	0.38
Total Acid Number	0.38	0.25	0.11	0.12	0.19	0.12	0.12
Friction Coefficient	0.48	0.49	0.46	0.46	0.42	0.35	0.35
Wear scar diameter (mm)	-	4.10	0.18	0.08	0.85	0.18	-0.12
Metal Compatibility							
Heat Resistance (Evaporation Amount %)	80.1	38.3	37.6	37.7	5.8	5.3	5.3

MPD: 3-methyl-1,5-pentanediol

MBDBP: 4,4'-methylenbis-2,6-di-t-butylphenol

DBPC: 2,6-di-t-butyl-p-cresol

Vanlube81: p,p'-dioctyldiphenylamine

VanlubeDND: di(nonylphenyl)amine

TCP: tricresyl phosphate

BT: benzotriazole

### (3) Consideration

(a) Table I shows that lubricating oil 1 made only of diesters of 3-methyl-1,5-pentanediol with n-hexanoic acid has a significantly large friction coefficient. As for heat resistance, lubricating oil 1 shows a large evaporation amount, and therefore cannot be tested for its metal compatibility.

(b) In comparison between the lubricating oils of Examples 2 to 4 and lubricating oils 2 to 4 (made of identical components to those of the lubricating oils of Examples 2 to 4 except for the diester moiety), the lubricating oils of Examples 2 to 4 have heat resistances (evaporation amounts) ranging from 5.3 to 5.8% according to the heat resistance test, which are superior to lubricating oils 2 to 4 which have heat resistances ranging from 37.6 to 38.3% according to the heat resistance test.

(c) In view of the above, the lubricating oils of Examples 2 to 4 are significantly superior in heat resistance.

### Experiment II

(1) The diester obtained in (1) of Experiment 1 was used to prepare lubricating oils 5 to 7 with the proportions (parts by weight) shown in Table II.

More specifically, lubricating oil 5 has the same composition as that of Example 10 with the exception of using diesters of 3-methyl-1,5-pentanediol with n-hexanoic acid instead of the diester (diesters of 3-methyl-1,5-pentanediol with n-heptanoic acid and n-octanoic acid) of Example 10. Lubricating oils 6 and 7 have the same compositions as those of Examples 10 with the exception of using diesters of 3-methyl-1,5-pentanediol with n-hexanoic acid, and the additives (c) and (d).

In Experiment II, antioxidant B: 2,6-di-t-butyl-p-cresol was used instead of antioxidant A: 4,4'-methylenebis-2,6-di-t-butylphenol, which was used for lubricating oils 2 to 4 of Experiment 1 and the lubricating oils of Examples 2 to 4. Then the lubricating oil properties were tested.

The obtained lubricating oils were tested for the kinematic viscosity, total acid number, friction coefficient, wear scar diameter (mm) and metal compatibility, in the same manner as described on page 42 line 9 to page 43 line 23 of the specification as filed. Table II shows the results. For ease of comparison, Table II also shows the results of Example 10 shown in Table 1 of the specification as filed.

Table II

Table II										
(a) Component	MPD di(n-hexanoate)	lubricating oil 5	lubricating oil 6	lubricating oil 7	Example 10					
	MPD (n-heptanoate/n-octanoate)	99.45	97.45	97.39	99.45					
(b) Component	A: MBDBP									
	B: DBPC	0.50	0.50	0.50	0.50					
	C: Vanlube81									
	D: VanlubeDND									
(c) Component	H: Palmitic acid	0.05	0.05	0.05	0.05					
	I: Stearic Acid		2	2						
	J: TCP			0.05						
	M: BT									
(d) Component	N: Propyl gallate			0.01						
	O: Lauryl gallate									
Labrlicant Properties	Kinematic Viscosity (mm <sup>2</sup> /s)	17.7	18.5	18.7	27.3					
		5.08	5.21	5.23	7.08					
		1.80	1.82	1.82	2.34					
	Viscosity Index	—	—	—	168					
	Total Acid Number	0.01	0.14	0.43	0.12					
	Friction Coefficient	0.12	0.11	0.12	0.13					
	Wear scar diameter (mm)	0.49	0.46	0.46	0.44					
	Metal Compatibility	4.60	0.50	0.40	3.85					
	Heat Resistance (Evaporation Amount %)	70.4	69.8	69.5	32.8					

DBPC: 2,6-di-t-butyl-p-cresol

Vanlube81: p,p'-dioctyldiphenylamine

VanlubeDND: di(nonylphenyl)amine

TCP: tricresyl phosphate

BT: benzotriazole

(2) Consideration

In comparison between the lubricating oil of Example 10 and lubricating oils 5 to 7, the lubricating oils of Example 10 has a heat resistance (evaporation amount) of 32.8% according to the heat resistance test, which is superior to lubricating oils 5 to 7 which have heat resistances ranging from 69.5 to 70.4% according to the heat resistance test. That is, the lubricating oil of Example 10 is significantly superior in heat resistance.

6. I, the undersigned, declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: December 20, 2007

By Yasuyuki Kawahara

Yasuyuki KAWAHARA